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(54) Title: ANTIMICROBIAL POLYALPHAOLEFIN COMPOSITION

(57) Abstract: The present invention relates to an antimicrobial polyalphaolefin composition comprising polyalphaolefin and trichlosan and/or paraben as antimicrobial compound(s). The composition may be used either as such in various applications, or as a starting material for producing products that should have antimicrobial properties.

### Antimicrobial polyalphaolefin composition

- 5 The present invention relates to an antimicrobial polyalphaolefin composition comprising polyalphaolefin and an antimicrobial compound. The composition may be used either as such in various applications, or as a starting material for producing products that should have antimicrobial properties.
- 10 Various antimicrobial formulations such as solutions, compositions for cleaning purposes and like are commonly used to disinfect surfaces and instruments. In technological, cosmetics, pharmaceutical and food industries as well as in hospitals, antimicrobial products are used to prevent the growth of microbes such as bacteria, fungi, moulds, and yeasts. Further, said products are used to control the health risk, and the
- 15 deterioration of products and the development of bad odour therein and the discoloration thereof due to microbes. In food industry, problems are caused by the protecting and lubricating oils used in machines and apparatuses allowing microbial e.g. *Listeria* bacterial growth under favourable conditions. Droplets of such contaminated lubricating oil entering the products form a serious health hazard.
- 20
- Patent NO 180104* discloses a liquid silicone oil containing antibacterial agents such as triclosan, and the use thereof to fill dental cavities in connection with dental bridges and prosthesis.
- 25 *Patent publication JP 07021091* presents a microbicidal polyolefin composition comprising polyolefins containing chlorine compounds, bactericidal compounds, phosphorus compounds, phenolic compounds and neutralizing compounds.

U.S. Patent 5,069,907 discusses cloth materials used in surgery. This material consists of synthetic polymer film or a cloth containing 0.01 – 25 % by weight of an antimicrobial agent, preferably 2,4,4'-trichloro-2'-hydroxyphenyl ether. Alternatively, the cloth may comprise so-called fastening agent between the skin and the cloth, mixed with said antimicrobial agent. Suitable fastening agents are the following: polyvinyl ether, acrylic binder, polyolefin, silicone binder, polyester, and polyurethane.

Patent application WO 99/37710 is directed to polymeric compounds containing at least one phenolic compound in an amount of 0.01 to 10 % by weight, the corresponding master batch, and the production and use thereof. The polymeric compounds mentioned include polyolefins selected in this case from: polyethylene and the derivatives thereof, LDPE, HDPE, LLDPE, EVA, EBA, EEA, EAS, EVK, ETFE, PEC, CSM, VPE, EPB, EPDM, ERM, polybutylene, and polyisobutylene. Phenolic compounds preferably mean 2,4,4'-trichloro-2'-hydroxyphenyl ether. Such end uses as boxes, containers and waste containers for storage and transportation are mentioned

Patent application FI 971338 discloses coatings of structures and profiled articles containing a mixture of thermoplastic elastomer with a non-elastomeric polyolefin, in general with homopolymers or random copolymers of propylene. An oligomer of poly- $\alpha$ -olefine type is used as the polyolefin plastisizer in a matrix plastic (EPR, EBR, EPBR, PBR, SBR, EPM, EPDM). The monomers used comprise at least 3 carbon atoms, preferably 6 to 12 carbon atoms. For example, reference is made to U.S. Patent 4,032,591 and EP Patent 318186 wherein 1-decene is mentioned.

Patent application WO 99/27792 discloses a concentrate containing biocides comprising zinc pyridine and another biocide, preferably a halogenated phenol, preferably

25 to 45 % by weight of 2,4,4'-trichloro-2'-hydroxyphenyl ether. Cleaning devices and plastic materials are mentioned as end uses. In addition, the production thereof is disclosed. The biocidal compound is dissolved in a plastisizer to be added to the polymer being produced. Suitable plastisizers are polybutylene, LDPE, LDPP, and  
5 paraffin wax.

Polyalphaolefins are liquid oils, the starting materials of which are monomers having most suitably 8 to 12 carbon atoms. The most common starting material is the decene (C<sub>10</sub>).

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The term polyolefin refers to all such thermoplastics wherein the carbon skeleton of the polymer is formed by polymerizing monomers having carbon-carbon double bonds. In this polymerization, these double bonds are opened to form carbon-carbon bonds between the monomers. These polyolefins include for instance polyethylene,  
15 polypropylene, EPR, SBR, EBA, EMA, and EVA.

The object of the present invention is to provide an antimicrobial polyalphaolefin composition comprising polyalphaolefin and antimicrobial compound/compounds, and the use of this antimicrobial polyalphaolefin composition for various applica-  
20 tions.

The characteristic features of the antimicrobial polyalphaolefin compositions of the present invention, and the uses thereof are disclosed in the appended claims.

25 It is found that colourless, odourless, tasteless and clear antimicrobial polyalphaolefin compositions may be produced from polyalphaolefins, preferably from polydecenes, and more preferably from food grade hydrogenated polydecenes by adding to this polydecene 0.01 to 30 % by weight of 2,4,4'-trichloro-2'-hydroxydiphenyl ether (triclosan), or 0.01 to 5 % by weight of n-propyl ester of hydroxybenzoic acid, or n-

methyl ester of hydroxybenzoic acid (paraben) or mixtures thereof, optionally by using heat.

Particularly preferable polydecenes are food grade polydecenes NEXBASE™  
5 2004FG, NEXBASE™ 2006FG, and NEXBASE™ 2008FG (Fortum Oil and Gas Oy). 0.01 to 30 % by weight of triclosan and/or 0.01 to 5 % by weight of paraben may be dissolved in polydecene at the temperature of 10 to 90 °C depending on the concentration desired. Thus, an oily antimicrobial composition is obtained that is suitable for several applications in food, pharmaceutical, technochemical, and cosmetics industry, and in hospitals. Further, it may also be used as an antimicrobial  
10 plastisizer in the plastics industry.

The composition of the invention may be used in food industry as a protecting and lubricating oil for machines to prevent in the oil the growth of microbes that are unwanted and hazardous to health, and further, to prevent the passing thereof from the  
15 oil to the products. Said antimicrobial compositions may also be used as protecting and lubricating oils of apparatuses in pharmaceutical industry to reduce any contamination risk. The antibacterial polyalphaolefin composition of the present invention may be used as such as a skin care oil and as a product to be applied on the skin in connection with the use of prostheses before the disposition thereof to prevent the  
20 microbial growth under the prostheses and unpleasant odour, and for other similar applications in connection with the use of prostheses. The antimicrobial composition of the invention may also be used to impregnate various wooden surfaces and wooden products particularly under circumstances where it is very important to prevent the unwanted growth of microbes and the deterioration of the wooden surface.  
25 Tooth picks impregnated with the composition of the invention may be mentioned as an example for such use. Moreover, the composition of the invention may be used to treat and polish leather.

The composition is also particularly useful as an antimicrobial plastisizer to simultaneously improve the antimicrobial properties of rubber mixtures, thermoplastic elastomers, thermoplastic vulcanizates and silicones. Plastisizing agents and oils are used in rubber mixtures (a), thermoplastic elastomers (b), vulcanizates thereof (c) and silicones (d) to plastisize the hardness of the product and to provide more flexible products having a soft surface and a lower residual compression, the products being suitable for lower working temperatures.

(a) Normally plastisized rubbers (elastomers):

- 10     EPR = ethylene-propylene rubber  
       EPDM = ethylene-propylene-diene rubber  
       NR = natural rubber  
       IIR = butyl rubber  
       ACM/EAM = polyacrylate rubber  
15     SBR = styrene-butadiene rubber  
       1,2-sPB = 1,2-syndiotactic polybutadiene rubber.

(b) Plastisized thermoplastic elastomers; polypropylene commonly as a crystalline thermoplastic in a mixture:

- 20     SBC = styrene-butadiene blockcopolymers,  
         unhydrogenated version     hydrogenated version  
         SBS                             SEBS  
         SB                                SEB  
         SI                                 SEP

25

EPR = ethylene-propylene rubber  
EPDM = ethylene-propylene-diene rubber  
NR = natural rubber  
IIR = butyl rubber

ACM/EAM = polyacrylate rubber

SBR = styrene-butadiene rubber

1,2-sPB = 1,2-syndiotactic polybutadiene rubber.

5 (c) Thermoplastic vulcanizates:

Vulcanization is accomplished while mixing either by means of a sulfur compound, organic peroxide, or with a phenolic resin according to the type of the elastomer.

(d) Silicones.

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In many cases, the use of a plastisizer lowers the raw material costs of the products and improves the processibility thereof. An advantage attained with the addition of a plastisizer is the improvement of the collapse resistance of an article made of thermoplastic elastomer exposed to oil in the environment. Plastisizers present in the product  
15 reduce the ability thereof to absorb additional hydrocarbons.

No plastisizers may be used in crystalline plastics since the crystalline structure will not tolerate the presence of an oil. Unplastisized plastics typically include polycarbonates, polyolefins (PE and PP), polyamides and polyurethanes. Compounding  
20 these plastics with elastomers provides in certain cases mixtures that may be plastisized.

With respect to performance, polyalphaolefins have several advantages in plastisizing applications. For instance:

25

- superior heat resistance is an important feature in medical apparatus and device applications requiring repeated sterilization or heating of the article in a microwave oven, for instance as a component of a food tray. There are also other appli-

cations profiting from the high heat resistance, such as cable applications and engine room applications in automobile industry.

- 5       – strictly limited composition, that is, a narrow molecular weight distribution allows for the selection of the desired molecular weight, thus minimizing the evaporation effects of the plastisizing agent or oil. In addition, the flash point of polyalphaolefin is generally higher at the desired viscosity than that of conventional mineral oils, this being favourable for processing. With respect to its quality, polyalphaolefin is a pure product, thus often facilitating the approval by the authorities.
- 10       – a low working temperature is an important characteristic of polyalphaolefins. They crystallize at very low temperatures, thus making possible to lower the brittle temperature of rubber or a thermoplastic elastomer. This property is particularly advantageous for styrene elastomers. In applications of the automobile industry,
- 15       the required lowest working temperature is commonly below  $-40^{\circ}\text{C}$ .

Since 2,4,4'-trichloro-2'-hydroxyphenyl ether (triclosan) is very soluble in polyalphaolefins, a triclosan concentration necessary for the improvement of the antimicrobial properties of an elastomer products may be attained in plastisizer application.

20   Moreover, the antimicrobial spectrum of triclosan is very wide, as the Table 1 below shows. By combining this wide spectrum antimicrobial activity with the favourable properties of polyalphaolefins, a composition particularly suitable for medical and medicinal apparatus and device applications and for seals of food packages is obtained.



Table 1

Microbiostatic effect of triclosan (Irgaguard B 1000)

5

Gram-positive bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Actinomyces bovis</i>	A		NA	1.0	
<i>Actinomyces israelii</i>	NCTC	8047	NA	1.0	
<i>Actinomyces naeslundii</i>	A		NA	1.0	
<i>Bacillus cereus</i>	A		NA	3.0	
<i>Bacillus cereus</i> var. <i>mycoides</i>	A		NA	3.0	
<i>Bacillus megatherium</i>	A		NA	3.0	
<i>Bacillus subtilis</i>	NCTC	8236	NA	0.1	
<i>Clostridium botulinum</i>	NCTC	3805	EA	3.0	
<i>Clostridium difficile</i>	ATCC	9684	BHI-A	5.0	
<i>Clostridium perfringens</i>	NCTC	3110	EA	10.0	
<i>Clostridium sporogenes</i>	A		EA	10.0	
<i>Clostridium tetani</i>	NCTC	9571	EA	3.0	
<i>Corynebacterium acnes</i> *	ATCC	6919	BHI-A	3.0	
<i>Corynebacterium diphtherias</i>	NCTC	3984	BHI-A	3.0	
<i>Corynebacterium minutissimum</i>	ATCC	23348	BHI-A	3.0	
<i>Corynebacterium xerosis</i>	ATCC	373	M-H	5.0	
<i>Enterococcus faecalis</i>	ATCC	29212	M-H	4.0	
<i>Enterococcus faecalis</i>	ATCC	6055	M-H	5.0	
<i>Enterococcus faecalis</i>	NCTC	12201	M-H	5.0	Varicomycin resistant
<i>Enterococcus faecalis</i>	NCTC	12203	M-H	5.0	Varicomycin resistant
<i>Enterococcus faecium</i>	ATCC	10541	BHI-A	3.0	
<i>Enterococcus faecium</i>	NCTC	8619	BHI-A	10.0	
<i>Enterococcus faecium</i>	ATCC	6057	M-H	4.0	
<i>Enterococcus arabinosus</i>	ATCC	8014	MACA	33.0	
<i>Lactobacillus delbrueckii</i>	ATCC	7830	MACA	33.0	
<i>Lactobacillus fermenti</i>	ATCC	707	MACA	33.0	
<i>Lactobacillus rhamnosus</i>	NCTC	7469	MACA	33.0	
<i>Listeria monocytogenes</i>	ATCC	15313	BHI-A	1.0	
<i>Micrococcus luteus</i>	ATCC	7468	M-H	4.0	
<i>Mycobacterium phlei</i>	A		BHI-A	0.3	

Gram-positive bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Mycobacterium smegmatis</i>	NCTC	8152	BHI-A	1.0	
<i>Mycobacterium tuberculosis</i>	A		YA	100.0	
<i>Nocardia asteroides</i>	NCTC	6761	BHI-A	3.0	
<i>Sarcina lutee</i>	NCTC	196	BHI-A	3.0	
<i>Sarcina urea</i>	ATCC	6473	BHI-A	0.1	
<i>Sporosarcina urea</i>	ATCC	6473	BHI-A	0.1	
<i>Staphylococcus aureus</i>	ATCC	29213	M-H	<0.125	
<i>Staphylococcus aureus</i>	NCTC	6571	NA	0.03	
<i>Staphylococcus aureus</i>	ATCC	9144	M-H	0.05	
<i>Staphylococcus aureus</i>	NCTC	6966	NA	0.1	
<i>Staphylococcus aureus</i>	ATCC	13709	NA	0.01	
<i>Staphylococcus aureus</i>	ATCC	6538	NA	0.01	
<i>Staphylococcus aureus</i>	NCTC	11940	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	12232	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	12493	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	12497	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	10443	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	10703	M-H	0.01	Methicillin resistant
<i>Staphylococcus aureus</i>	NCTC	11150	M-H	0.02	Methicillin resistant
<i>Staphylococcus albus</i>	NCTC	7292	NA	0.1	
<i>Staphylococcus epidermidis</i>	ATCC	12228	M-H	<0.125	

Gram-positive bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Staphylococcus hominis</i>	ATCC	27844	M-H	1.0	
<i>Staphylococcus hyicus</i>	NCTC	7944	BHI-A	0.03	
<i>Staphylococcus lactis</i>	NCTC	8340	NA	3.0	
<i>Staphylococcus saprophyticus</i>	NCTC	7292	NA	0.1	
<i>Streptococcus agalactiae</i>	NCTC	8181	BHI-A	3.0	
<i>Streptococcus hemolyticus A</i>	A		BHI-A	3.0	
<i>Streptococcus pneumoniae</i>	ATCC	33400	M-H	4.0	
<i>Streptococcus pyogenes</i>	ATCC	21059	M-H	4.0	
<i>Streptococcus saprophyticus</i>	ATCC	15305	M-H	0.125	
<i>Streptococcus coelicolor</i>	A		BHI-A	1.0	

Gram-negative bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Aerobacter arogenes</i>	CTTM	413	NA	1.0	
<i>Acinetobacter lwoffii</i>	ATCC	15309	M-H	0.125	
<i>Alcaligenes faecalis</i>	A		NA	>100	
<i>Bacteroides fragilis</i>	ATCC	23745	M-H	2.0	
<i>Brucella abortus</i>	NCTC	8226	B.R.A.A.	0.1	
<i>Brucella intermedia</i>	A		B.R.A.A.	0.1	
<i>Citrobacter freundii</i>	A		NA	3.0	
<i>Enterobacter aerogenes</i>	ATCC	13048	M-H	0.5	

Gram-negative bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Enterobacter cloacae</i>	ATCC	13047	M-H	0.5	
<i>Enterobacter sakazakii</i>	NCTC	8155	NA	0.3	
<i>Escherichia coli</i>	NCTC	9663	NA	0.3	
<i>Escherichia coli</i>	NCTC	11186	M-H	0.5	Tobramycin resistant
<i>Escherichia coli</i>	ATCC	8196	M-H	0.02	
<i>Escherichia coli</i>	ATCC	9661	NA	0.3	
<i>Escherichia coli</i>	ATCC	11229	M-H	0.5	
<i>Escherichia coli</i>	ATCC	25922	M-H	0.25	
<i>Escherichia coli</i>	ATCC	10536	BHI	0.5	
<i>Escherichia coli</i>	ATCC	35150	M-H	0.2	Serotype 0157
<i>Escherichia coli</i>	ATCC	4388	M-H	0.1	Serotype 0157
<i>Escherichia coli</i>	ATCC	43889	M-H	0.2	Serotype 0157
<i>Escherichia coli</i>	ATCC	43890	M-H	0.2	Serotype 0157
<i>Haemophilus influenza</i>	ATCC	33391	B-A	2.0	
<i>Klebsiella aerogenes</i>	NCTC	8172	NA	0.3	
<i>Klebsiella edwardsii</i>	NCTC	7242	NA	0.3	
<i>Klebsiella oxytoca</i>	ATCC	43165	M-H	1.0	
<i>Klebsiella pneumoniae</i>	ATCC	4352	NA	0.3	
<i>Klebsiella pneumoniae</i>	ATCC	10031	M-H	0.125	
<i>Loefflerella mallei</i>	NCTC	9674	NA	0.3	
<i>Loefflerella pseudomallei</i>	NCIB	10230	NA	1.0	
<i>Moraxella glucidolytica</i>	A		NA	0.3	
<i>Moraxella lwoffii</i>	A		NA	0.1	
<i>Neisseria catarrhalis</i>	NCTC	3622	BA	33.0	
<i>Pasteurella pseudotuberculosis</i>	C-G		NA	10.0	
<i>Pasteurella septica</i>	NCTC	948	NA	0.1	
<i>Proteus mirabilis</i>	ATCC	14153	M-H	0.5	
<i>Proteus vulgaris</i>	NCTC	8313	NA	0.1	
<i>Proteus vulgaris</i>	NCTC	4636	NA	0.3	
<i>Pseudomonas aeruginosa</i>	ATCC	12055	NA	>1000	
<i>Pseudomonas aeruginosa</i>	NCTC	8060	NA	>1000	
<i>Pseudomonas fluorescens</i>	NCTC	4755	NA	>100	

Gram-negative bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Salmonella enteritidis</i>	A		NA	0.1	
<i>Salmonella paratyphi A</i>	NCTC	5322	NA	0.3	
<i>Salmonella paratyphi B</i>	NCTC	3176	NA	0.3	
<i>Salmonella paratyphi B</i>	NCTC	5704	NA	0.1	
<i>Salmonella typhimurium</i>	NCTC	5710	NA	0.3	
<i>Salmonella typhi</i>	NCTC	8384	NA	0.3	
<i>Salmonella typhi</i>	NCTC	786	NA	0.3	
<i>Serratia marcescens</i>	ATCC	14756	M-H	>512	
<i>Shigella dysenteriae</i>	NCTC	2249	NA	0.1	
<i>Shigella flexneri</i>	NCTC	8192	NA	0.3	
<i>Shigella flexneri</i>	NCTC	8204	NA	0.1	
<i>Shigella sonnei</i>	NCTC	7240	NA	0.1	

Gram-negative bacteria	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Vibrio cholerae</i>	A		NA	10.0	
<i>Vibrio eltor</i>	NCTC	8457	NA	10.0	

Molds and yeast	Origin	Strain No.	Medium	IRGAGUARD B 1000 [ppm]	Comment
<i>Aspergillus fumigatus</i>	ATCC	9197	SMA	10	
<i>Aspergillus niger</i>	ATCC	6275	M	30	
<i>Candida albicans</i>	ATCC	10259	M	3	
<i>Candida albicans</i>	A		SMA	10	
<i>Candida paracrusi</i>	A		SMA	4	
<i>Candida parapsylosis</i>	A		SMA	30	
<i>Candida stellatoidea</i>	A		SMA	10	
<i>Candida tropicalis</i>	A		SMA	10	
<i>Candida tropicalis</i>	DSM	1346	M-H	10	
<i>Candida utilis</i>	A		SMA	33	
<i>Epidermophyton floccosum</i>	ATCC	10227	SMA	1-10	
<i>Keratinomyces ajelloi</i>	A		SMA	10	
<i>Microsporum canis</i>	ATCC	10214	SMA	3	
<i>Pityrosporum ovalae</i>	ATCC	14521	M	>1000	
<i>Trichophyton cutaneum</i>	A		SMA	10	
<i>Trichophyton mentagrophytes</i>	ATCC	9533	SMA	1	
<i>Trichophyton rubrum</i>	A		SMA	10	
<i>Trichophyton tonsurans</i>	A		SMA	10	

**Key**

Media		Origin	
NA	Nutrient Agar	CITM	official culture collection
BA	Blood Agar	DSM	German Collection of Microorganisms (Germany)
BR.A.A.	Brucella Agar Albimi	NCTC	National Collection of Type Culture (UK)
MACA	Micro Assay Culture Agar	ATCC	American Type culture collection (USA)
BHI-A	Brain Heart Infusion Agar	C-G	Ciba
EA	Eugon Agar	A	Bacteriological or veterinary Institutes
YA	Younans Agar		
M	Mycophil Agar		
SMA	Sabouraud Maltose Agar		
M-H	Muller Hinton Agar		

- 5 Elastomers and plastics used in medical applications and having a very high compatibility with polyalphaolefins include:

	Type of plastic	Most common plastisizers	Compatibility with polyalphaolefins
10	PP/EPDM	Paraffin oil, naphtalene oil	Very high
	PP/SBC	Paraffin oil, naphtalene oil	Very high

Next, the use of antimicrobial polyalphaolefin composition of the invention as plastisizing agents in plastics is discussed in more detail.

15

1. Use of an antimicrobial polyalphaolefin composition in elastomers:

PP/EPDM or PP/EPR blend

	Raw material	%, by weight	
	EPDM or EPR	5 to 80	
	Polypropylene	15 to 90	
	Plastisizer 1	5 to 30	polyalphaolefin
5	Plastisizer 2	0 to 35	mineral oil
	Antimicrobial compound	0.1 to 30	triclosan
	Antioxidant	0 to 0.3	
	Peroxide	0 to 0.1	di-tert-butyl peroxide
	Internal lubricant	0 to 0.2	magnesium stearate

10

2. Use of a antimicrobial polyalphaolefin composition in styrene based thermoplastic elastomer: SEBS blend.

	Raw material	% by weight	
15	SEBS	30 to 50	
	CaCO <sub>3</sub>	0 to 20	
	Polypropylene	0 to 30	
	Plastisizer 1	5 to 30	polyalphaolefin
	Plastisizer 2	0 to 35	mineral oil
20	Antimicrobial compound	0.1 to 30	triclosan
	Antioxidant	0 to 0.3	

The combination PP/SEBS is generally used in those applications of styrene elastomers that are more demanding with respect to working temperature and environmental pollution.

25

Typical medical uses of elastomers are syringes and needles, intravenous, urinary catheters, dosage tubings and devices, clinical cardiac valves and vessel implants, disposable packages and trays.

The antimicrobial polyalphaolefin composition of the invention has several advantages. At lower concentrations of the antimicrobial agents, preferably at 0.01 to 5 %, more preferably 0.1 to 2 % by weight, the composition may be used as a skin oil, or  
5 on the skin in connection with prosthesis, and further, to impregnate leather and wooden surfaces. According to studies, reddening, abrasion, callousness and infections of the skin are reduced by more than 80 % among carriers of prosthesis. Thus, the spreading and growth of microbes and the accompanying health risk may be prevented, and the deterioration of products hindered.

10

In food and pharmaceutical industry, contamination of products by unwanted microbes is both a serious economic risk factor and a health hazard to the consumers. The risk of microbial contamination may be reduced and prevented by using the antimicrobial polyalphaolefin composition of the invention containing 0.1 to 5 %, preferably 0.1 to 2 % by weight of the antimicrobial agent as the protecting and lubricating oil in apparatuses wherein the oil may find its way into the product contacting  
15 them.

In skin care applications, moisturizing and repairing properties of the antimicrobial polyolefin may be improved by adding vitamin compounds (retinyl palmitate or vitamin A, and tocopherol acetate or vitamin E) soluble in fat. As is known, vitamins A and E effectively moisturize the skin, alleviate effects due to ageing, and promote the renewal thereof. Vitamin E is also an antioxidant.

20 Antimicrobial polyalphaolefin oil containing vitamins may be used as plasticizer for instance in silicone materials and elastomers. It is possible to produce a material extending oil that is very comfortable in use. For instance, it may be used to treat wounds and burns since it will not stick to the skin and has nourishing properties.

In plastisizer applications, the antimicrobial polyalphaolefin composition has important advantages, including the possibility to incorporate antimicrobial triclosan into plastic in an amount of 0.01 to 30 % by weight, and/or a desired amount of paraben dissolved in polydecene. Further, the ratio of polydecene to antimicrobial agent may be freely adjusted by means of optional heat during dissolution of the agent, and the amount of polydecene. The composition optionally having a temperature of 10 to 90 °C may be mixed to elastomers and plastics during the production thereof preferably to obtain a content of triclosan of 0.1 to 1.0 % by weight of the plastic product. In this manner, the preparation of separate "master batches" is avoided, thus lowering the costs and reducing process steps. Elastomer and plastic products particularly useful in medical and medicinal apparatus applications are thus obtained. In such final uses, it is extremely important to be able to prevent and/or reduce growth of unwanted microbes on apparatuses and devices, thus considerably lowering the costs due to infections caused by such unwanted microbes among patients. Medical applications have several special requirements on materials such as resistance to sterilization. These requirements are restricted in no way by the composition of the invention.

The invention will now be illustrated in more detail with the following examples without wishing to limit it to these exemplary solutions.

#### Example 1

##### Bacteriostatic effect of the antimicrobial polydecene composition

The antimicrobial composition of the invention comprised hydrogenated polydecene and 0.3 % by weight of triclosan. The activity of the composition was tested and the composition was found to have a bacteriostatic effect on *Staphylococcus aureus* NCTC4163, *Escherichia coli* NTCT10538, *Klebsiella pneumoniae* ATCC27736, and *Proteus vulgaris* NTCT4635 strains.



**Example 2**

Tooth picks were impregnated with an antimicrobial polydecene composition of the invention containing 0.3 % by weight of triclosan. The picks were then cultivated on a plate with the bacterium *Staphylococcus aureus*. It was found that the growth of the bacteria was effectively inhibited.

A photo of a cultivation plate of the tooth picks is shown in Figure 1.

10

**Use of antimicrobial polyalphaolefin composition in plastisizers****Example 3****Elastomer: EPDM or PP/EPR blend**

	Raw material	% by weight	Products
20	EPDM or EPR	59.8 / 59.5	Vistalon 805 / Nordel IP 3745P
	Polypropylene	29	Escorene PP 4152
	Plastisizer 1	10	polydecene
	Plastisizer 2	0	mineral oil
	Antimicrobial agent	0.3	triclosan
25	Antioxidant	0.3	Irganox B-225
	Peroxide	0.1	di-tert-butyl peroxide
	Internal lubricant	0.2	magnesium stearate

With the composition of the example, good processing characteristics and a Shore A hardness of 85 are attained. In addition, the antimicrobial properties of the composition are comparable to those in preceeding examples. Thermal ageing properties of the mixture are also especially good.

5

**Example 4****Styrene based thermoplastic elastomer: SEBS blend**

- 10 The example is directed to a basic SEBS blend. The combination PP/SEBS is generally used in those applications of styrene elastomers that are demanding with respect to working temperature and environmental pollution.

	Raw material	% by weight	Products:
15	SEBS	30	Shell Kraton G-1651
	CaCO <sub>3</sub>	15	Omycarb 2A, OMYA
	Polypropylene	13.4	Escorene PP 4152
	Plastisizer 1	35	polydecene
	Plastisizer 2	0	mineral oil
20	Antimicrobial compound	0.3	triclosan
	Antioxidant	0.3	Irganox B-225

- The ability to plastisize SEBS elastomers greatly depends on the styrene content thereof. An elastomer with a low styrene content accepts plastisizer more than 1.5  
25 times its own weight. The antimicrobial properties of the exemplary mixture are comparable to those in examples 1 and 2.

**Example 5**

AATCC method 147 – 1998 (Antimicrobial Activity of Textile Materials: Parallel Streak Method) was used as the test method. Test microbes (*Staphylococcus aureus*) were cultivated on blood plates according to sensitivity assay technique. The prepa-  
5 rates were placed in contact with the agar, and the plates were incubated at 35 °C over night. The bacteriostatic activity was assayed as the width of the inhibition zone around the sample or as reduced growth under the sample.

10 **Table 1** Antimicrobial activity of elastomers

	EPDM	SEBS
Inhibition zone, mm	12	10
Inhibition zone, mm, 100 h at 125 °C	4	2
Inhibition zone, mm, 240 h at 125 °C	1	no growth under sample

The antimicrobial properties of the blend make it very suitable for instance for medi-  
cal applications. Antimicrobial properties of the elastomers are not lost even after  
15 extended heat treatment.

## Claims

1. Antimicrobial polyalphaolefin composition, characterized in that said composition comprises polyalphaolefin and 0.01 to 30 % by weight of 2,4,4'-trichloro-2'-hydroxyphenyl ether, and/or 0.01 % by weight of paraben as antimicrobial compounds.
2. Antimicrobial polyalphaolefin composition of Claim 1, characterized in that said polyalphaolefin is a hydrogenated polydecene.
3. Antimicrobial polyalphaolefin composition of Claim 1 or 2, characterized in that said composition comprises vitamin A and/or E.
4. Use of an antimicrobial polyalphaolefin composition of Claim 1 or 2 as a protecting and lubricating oil in food, technochemical, and pharmaceutical industries.
5. Use of an antimicrobial polyalphaolefin composition of Claims 1 to 3 in cosmetics industry, and the use thereof as a skin care oil, or on the skin in connection with the use of prostheses.
6. Use of an antimicrobial polyalphaolefin composition of Claim 1 or 2 for impregnation of wooden products and wood, and for the treatment and polishing of leather.
7. Use of an antimicrobial polyalphaolefin composition of Claim 1 or 2 as a plasticizer in rubber mixtures, thermoplastic elastomers, thermoplastic vulcanizates, and silicones to improve the antimicrobial properties thereof.

8. Process for producing rubber mixtures, thermoplastic elastomers, thermoplastic vulcanizates, and silicones, characterized in that an antimicrobial polyalphaolefin composition of Claim 1 or 2 is used as the plastisizer in said production.

- 5 9. Process of Claim 8, characterized in that said antimicrobial polyalphaolefin composition is added to said rubber mixtures, thermoplastic elastomers, thermoplastic vulcanizates, and silicones, optionally heated to a temperature between 10 and 90 °C, to the final concentration of 0.1 to 1.0 % by weight of 2,4,4'-trichloro-2'-hydroxyphenyl ether, and/or paraben in plastic product.

10

10. Process of Claim 8 or 9, characterized in that said thermoplastic elastomer is a PP/EPDM or PP/EPR blend or a styrene based thermoplastic elastomer, preferably a SEBS blend.

1/1

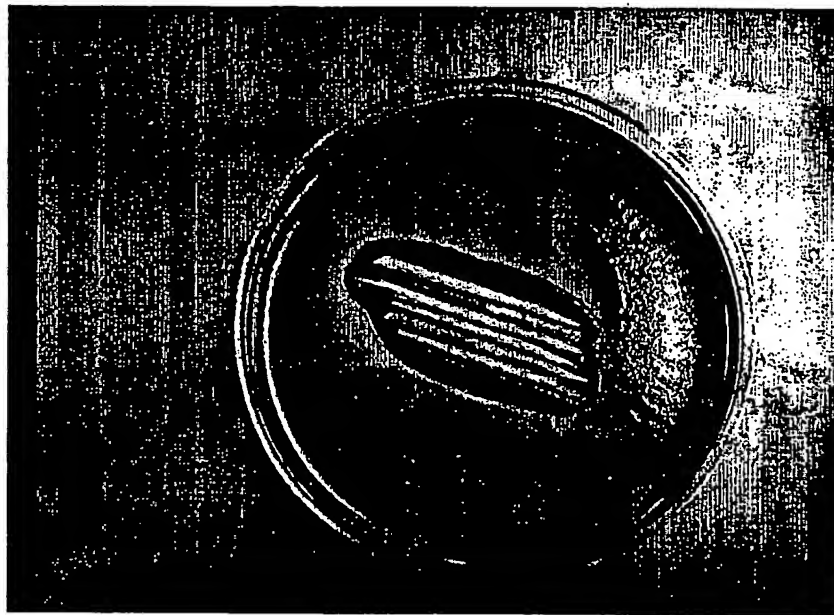


FIG. 1

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 01/00887

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A01N 25/00, A01N 31/16, A01N 37/40, A61K 7/00, A61K 7/48, B27K 3/38,  
B27K 3/40, A23L 3/34 A23 L 1/03, C14C 9/00, C14C 11/00

According to International Patent Classification (I-C) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A01N, A61K, A23L, C14C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, CHEM. ABS DATA

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9937710 A1 (GEBR. OTTO KG), 29 July 1999 (29.07.99) --	1-10
X	US 5069907 A (GROVER C. MIXON ET AL), 3 December 1991 (03.12.91). --	1-10
X	WO 9927792 A1 (NOVAPHARM RESEARCH (AUSTRALIA) PTY. LTD.), 10 June 1999 (10.06.99) --	1-10
X	WO 9952362 A1 (PHOENIX MEDICAL TECHNOLOGY, INC.), 21 October 1999 (21.10.99) -- -----	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/FI 01/00887

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